

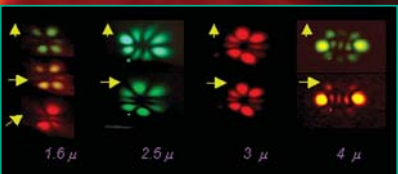
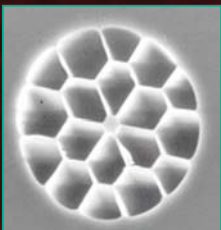
Materials Science and Technology Division

Think Small, Think Fast

Materials researchers at Los Alamos “think small and fast” in an effort to develop novel nanoscale materials with unique functions. Their goal is to control material properties on atomic time and length scales. To meet this challenge, they are developing the scientific principles governing the design and performance of nanoscale materials. Essential to this process are the fabrication and characterization of materials on nanometer and femtosecond scales.

Nanophotonics: Ultrafast Nonlinear Optics in Microstructured Fibers

A new way of manipulating light, nanophotonics, is made possible by novel optical devices whose complex structures have spatial scales on the order of optical wavelengths or smaller. Nanophotonics has potential applications ranging from telecommunications to health care and national security.

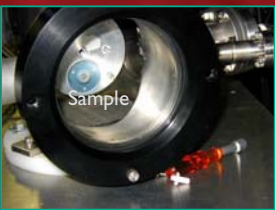


Photonic Crystal Fibers

The photonic crystal fiber above is a type of optical waveguide. A web of air channels runs along the length of the fiber, shown here in cross section. Ultrafast laser-light pulses introduced into these channels produce output pulses at the third harmonic frequency with the profiles shown at left. The structural design and spatial scales of these fibers determine their optical properties. Such waveguides could speed up optical information processing.

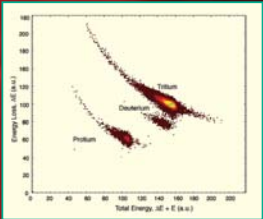
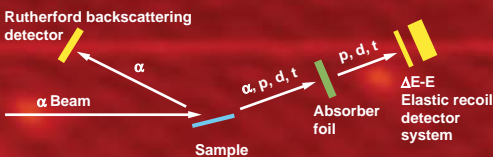
The Ion Beam Materials Laboratory

Researchers use a 3-million-electron-volt tandem accelerator and a 200-kilovolt ion implanter to analyze nanostructured materials nondestructively and to fabricate materials on nanometer and micrometer scales.



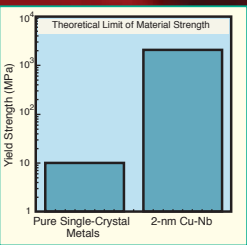
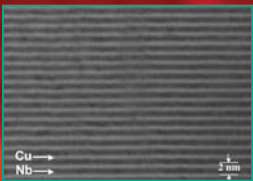
Nondestructive Analyses

In the analysis chamber (left), researchers measure the hydrogen isotopes in a tritium-loaded nanostructured film (blue sample) to study loading characteristics and efficiency. The schematic below illustrates basic principles of the ion-beam analysis process. The graph shows accumulated scattering events (“islands”) from each isotope. The relative concentration of each hydrogen isotope is obtained from the total number of particles in each island.



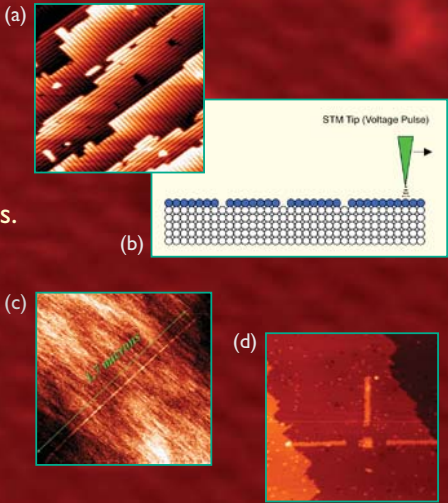
Think Small, Think Strong

By depositing, atom by atom, alternating nanometer-scale layers of copper and niobium, Los Alamos materials researchers have created a new class of composites that are two orders of magnitude stronger than a pure single-crystal metal. Electron microscopy enables detailed imaging of the material microstructures to the atomic level.



Miniaturizing Electronic Devices

Higher computational capacity and speed call for miniaturized electronic devices. Los Alamos researchers use scanning tunneling microscopy (STM) to prepare and characterize semiconductor surfaces for fabrication of single-electron transistors.



STM-Based Lithography

(a) The surface is cleaned and covered with a monolayer of hydrogen atoms. (b) Voltage pulses selectively remove one or more hydrogen atoms at preprogrammed positions to create the desired pattern. (c) A single line was etched by the STM tip. (d) Several such lines form the basis for a single-electron transistor.

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